Fluctuations in the Population Density of Sepsid Flies Attacking Cattle in Aligarh

Dissertation
submitted in partial fulfilment for the degree of
Master of Philosophy
in
ZOOLOGY
of
The Aligarh Muslim University, Aligarh

By
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DEPARTMENT OF ZOOLOGY
Aligarh Muslim University, Aligarh
September 1976

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D E D I C A T E D

TO

MY

FATHER

IN

GRATITUDE

23.9.76

I certify that "Fluctuations in the population density of Sepsid flies attacking cattle in Aligarh" is the original work of Miss. Yasmin Hanfi and is suitable for the award of the degree of Master of Philosophy of the Aligarh Muslim University, Aligarh. This work has been done by the candidate under my supervision.

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INTRODUCTION

Flies belonging to the family Sepsidae are usually yellowish, shining black or metallic brown in colour. The abdomen is thin at the waist and the head is rounded. The proboscis is short and there are three antennal segments. The arista is laterally situated. Sexes may be easily distinguished by the shape of the abdomen which is pointed in the males and blunt and rounded in the case of the females.

The members of the family Sepsidae are of considerable importance from the medical and veterinary point of view. They are not only a nuisance to the livestock but may also cause myiasis in them. The larvae feed on decomposing animal and vegetable matter; garbage and manure of all kinds.

Usually the gastrointestinal and genitourinary myiasis is caused by these flies (Herms, 1943). The infection is acquired either through the migration of larvae from the intestinal tract or the flies may deposit eggs or larvae on the genital apertures of the hosts. The larvae may infest urinary bladder and genital passages of human beings (James, 1947). A case of nasal myiasis has also been reported by Melander and Spuler (1917).

It is, however, surprising that inspite of all this importance, our knowledge of the bionomics and control of Sepsid flies is fragmentary and very little has been accomplished towards their eradication. Only preliminary observations have been made on the biology of these flies by some workers such as Seguy (1923), Ringdahl (1924), Duda (1925), Goetghbuer and Bastin (1925). It was therefore considered desirable to study the bionomics of three species, Sepsis nitens Wd., Sepsis albopunctata Lamb. and Australosepsis niveipennis Beck. which are commonly found attacking livestock in Aligarh. An attempt has also been made to study the occurrence of these species under varying conditions of the environment.

REVIEW OF LITERATURE

Hammer (1941) observed that during copulation the males of *Sepsidimorpha species* stood at right angles to the females with their heads close to them. The couples hovered over the masses of dung and copulation was effected. The males continued swinging their wings but the females did not make any noticeable movement. He further observed that *Sepsis spet* forced its eggs into the humid dung, with their appendage protruding out of the surface of the dung (Hammer, 1936). Since the oxygen content of the dung was poor, it was concluded that the appendage had a respiratory function. Hafez (1948) found that the maximum number of eggs of *Sepsis lateralis* were laid near the edges of buffalo dung masses. Every few seconds during oviposition, the female raised the tip of its abdomen upwards probably to pull the respiratory appendage after the eggs had been laid. Hafez (1948) believes that owing to a high almost 85.0 to 90.0 per cent water content of the cow dung and because of the surface crust formation, evaporation from the dung surface is lessened. Moist dung shows a stronger ability to attract the flies than a dry heap. Even if the dung is moist from inside, the flies may not be attracted towards it probably because of a hard dry crust on the surface. If, however, the upper dried surface of the dung

mass was removed the inside could still attract the flies for oviposition. This ability was, however, reduced to a minimum or completely disappeared when the dung mass was three-day-old. This may be due to the dung losing its characteristic smell and undergoing chemical changes (Hafez, 1948).

Howard (1900) in his paper "A contribution to the study of the insect fauna of human excrement" has listed a number of species of Diptera which he reared from different kinds of dung. Sepsis viollela was extremely abundant in human excrement and could also be reared in cow manure (Pratt, 1912). Thomsen and Hammer (1936) found Sepsis spet to be extremely abundant in cow, buffalo, calf, and pig dung. Mellor (1920) studied the biology of Sepsid flies in fowl dung. The larvae preferred the deepest part of the manure so as to escape sun light and have a full movement.

The structure of a Sepsid egg was first described by Portschinsky (1891). It is oval in shape and is provided with a long appendage at the anterior end. The surface is reticulately sculptured. Hafez (1948) measured the egg of Sepsis lateralis and found it to be about 0.5 millimeter long and 0.14 millimeter broad as the anterior end with a long respiratory appendage nearly four times the length of the egg. When about to hatch, the egg of Sepsis lateralis was found to split along two small

sutures situated anteriorly on either side of the egg. The incubation period in this case was found to be about 10.00 hours at a temperature ranging between 27.0 degree centigrade and 28.0 degree centigrade (Hafez, 1948).

The larvae of Sepsid flies are usually dung feeders and it is believed that the coprophagus larvae feed on micro-organisms which are abundant in the dung (Baumberger, 1919 and Hammer, 1941). Yeast powder if added to the synthetic diet can fulfil the accessory nutritional requirements of nitrogen and essential amino acids (Roeder, 1953).

There are three larval instars (Hafez, 1948). At the time of pupation the third instar larvae congregated on the upper surface of a dung mass and pupation occurred either on the surface or in the upper part of the dung mass at a depth of about 5.0 centimeters (Hammer, 1936). Pupae are small in size being 2.0 to 2.5 millimeter in length. The anterior end is rounded while the posterior is provided with two spines. The duration of the pupal stage is quite short. In the case of Saltelliseps niveipennis, Sepsis lateralis and Sepsis thoracica, Hafez (1948) found it to last for forty eight hours at a temperature of 27.0 degree centigrade to 28.0 degree centigrade.

IMMATURE STAGES

The eggs of Sepsis nitens, Sepsis albopunctata and Australosepsis niveipennis are deposited in freshly defecated masses of cattle dung. They prefer cow and buffalo dung for depositing their eggs. Horse dung is a less preferred site and the present author could not observe oviposition on any such mass. This may be due to the high temperature of horse dung which may be 36.0 degree centigrade to 38.0 degree centigrade even at the surface in contrast to cow and buffalo dung in which the temperature is generally less than 32.0 degree centigrade.

The author could not obtain any eggs under laboratory conditions though oviposition was commonly observed near the edges of dung masses in open fields. When a dung mass dried, a hard crust was formed on its surface and this prevented oviposition by the females. Some females could, however, be seen depositing their eggs in the cracks and crevices which were formed due to breaking up of the surface crust.

Masses of cattle dung were brought to the laboratory after the females had oviposited and were kept in rearing jars, 4.0" x 6.0" in size and having a 1.0" to 1.5" thick layer of sand at the bottom. The sand was kept moist by pouring water

from time to time. The eggs hatched in about 12.00 hours in the case of all the three species at a temperature ranging between 26.0 degree centigrade and 32.0 degree centigrade.

The larva:

The newly hatched larvae clustered round the periphery of a dung mass and could be easily recognized by the presence of spines at their posterior ends. The jumping habit of the larvae is a characteristic feature. When in the third instar, the larva inserts its mouth-parts into the notches of the last segment and then through a sudden releasing motion propels itself to a distance of about four to five inches. In this way the larvae may congregate on the upper surface of the dung mass and jump from one place to the other probably in search of food. The larvae feed on sewage and other filthy liquids found in the dung.

There are three larval instars. The first instar larvae burrow deep inside the breeding medium usually at a depth of 4.0 to 5.0 centimeters. However, when the oxygen supply in dung mass is lowered, the larvae may move to the surface. At this stage the beetles present in dung mass ensure a rich oxygen supply by making tunnels in the dung mass. The first larval instar lasts for 22.00 hours to 28.00 hours.

The second instar larvae are found deeper in the dung mass. By the time these larvae reach the second instar, the

dung is about 40.00 hours old and a hard crust is formed on its surface. The crust breaks open and crevices may appear in it. It has been observed that the presence of dung beetles may hasten crust formation and may decrease the nutritive value of the dung (Hafez, 1939). The duration of the second larval instar in case of all the species varied from 34.00 hours to 36.00 hours.

As the upper region dried, the third instar larvae, burrowed still deeper in the dung mass and made access to whatever moisture remained at the bottom. The third instar lasted for 40.00 hours to 46.00 hours thus the total duration of larval period was found to be about 4.0 to 5.0 days in all the three species.

The pupa:

Though the pupae of Sepsid flies are usually found in the upper region of the dung mass or just below the surface crust, they may also climb up the wall of a glass jar for pupation.

The pupae of S. nitens are 2.0 to 2.5 millimeter long and 1.0 to 1.2 millimeter broad with pointed ends. The posterior end is provided with two small spines. When freshly formed, the pupae are browmish yellow but the colour changes to light brown within a period of about 24.00 hours. The duration of pupal

period was found to be 3.4 days in the case of *Sepsis nitens* at 26.0 degree centigrade to 32.0 degree centigrade and relative humidity 58 ± 1 per cent.

THE ADULTS

Adults belonging to the family Sepsidae are the dominant members of the insect fauna of cattle dung (Hammer, 1941). The flies are rarely found indoors. Indian species have been studied by Brunetti (1909).

The three species commonly found in Aligarh are Sepsis nitens, Sepsis albopunctata and Australosepsis niveipennis.

S. nitens is a metallic brown species with head wider than long. The first antennal segment is provided with a row of long setae on its apical margin. The second segment has two long setae and the third bears an arista on its dorsal side with sensoria on its ventro-lateral margin. The thorax is brownish in colour. Apical margin of the wings are provided with an infuscated patch. Of the six longitudinal veins, the fourth, fifth and sixth arise from a common stalk. Abdominal segments are heavily setose (Plate - 1).

S. albopunctata, though greatly resembling S. nitens, is a dark brown species having yellow puncts all over the body. The second segment of antenna has a long seta but a row of small setae on its apical margin is absent. The third segment is

PLATE - 1

Sepsis nitens Wd.; Adult.

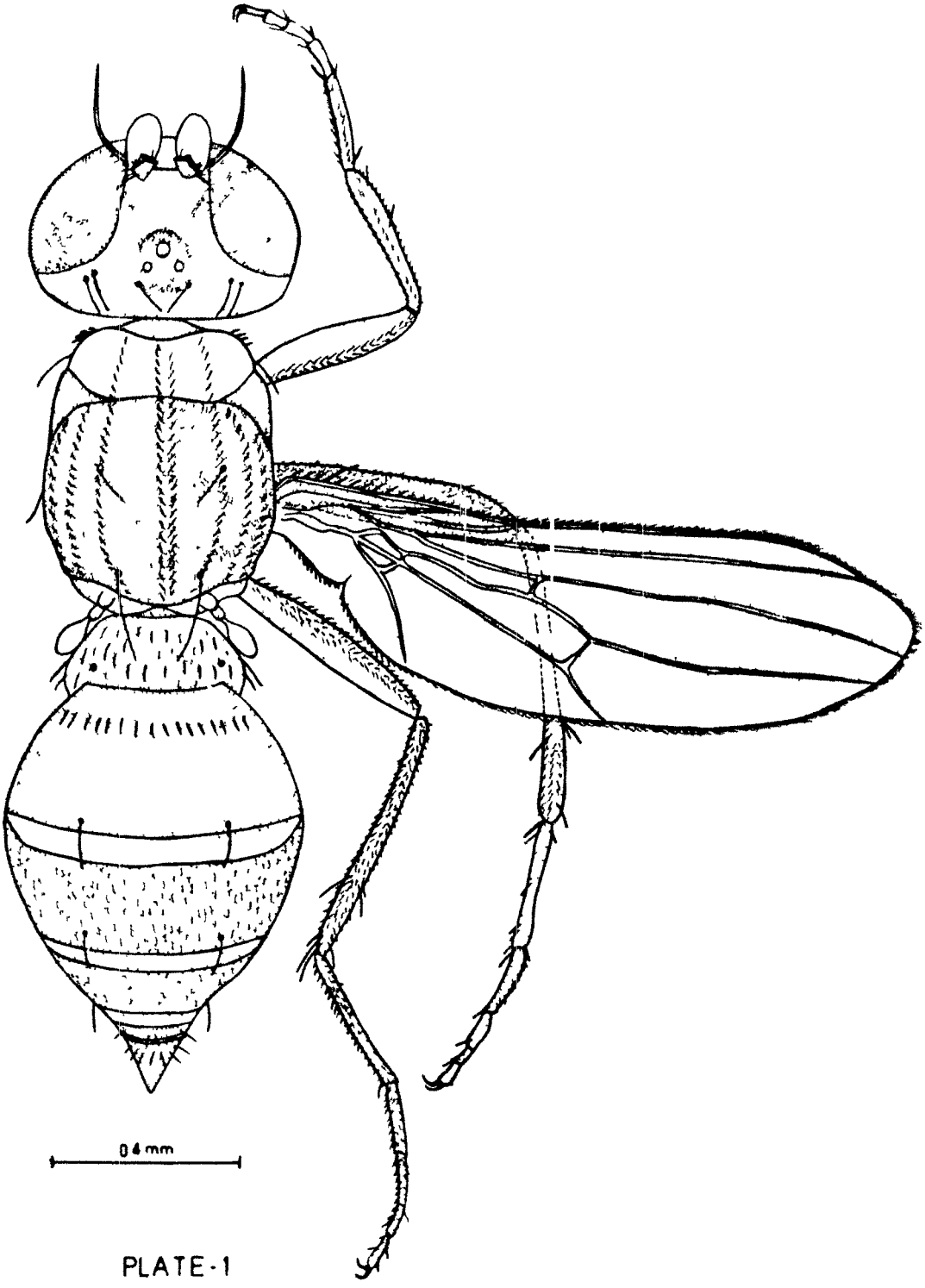


PLATE-1

without a sensoria. The fourth longitudinal vein arises from the basal vein while fifth and sixth arise from a common stalk (Plate - 2; C,D).

A. niveipennis is a yellow coloured fly. The antennae are also yellowish but the arista and setae are brown in colour. The second antennal segment has a seta on its dorsal margin. The shape of the wings and wing-venation is similar to that of S. albopunctata (Plate - 2; A, B).

Mating:

The mating behaviour of Sepsid flies was first studied by Hammer (1941) in the case of Sepsidimorpha species.

It was observed that males first start settling on the edges of the dung heap and then approach the females. The male stood at right angles to the female with its head close to her. Within 5.00 to 10.00 seconds their bodies became parallel to each other and then the male jumped on the female and copulation started.

During present studies a large number of flies were seen in copula in the months of March and September when temperature in the field ranged from 22.0 degree centigrade to 36.0 degree centigrade. In one instance 250 to 300 flies were observed over a single dung heap measuring 1500.0 square

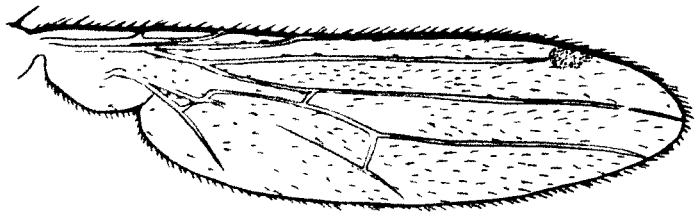
PLATE - 2

Figure, A - B; *Australosepsis niveipennis*,

(A) Forewing; (B) Antenna

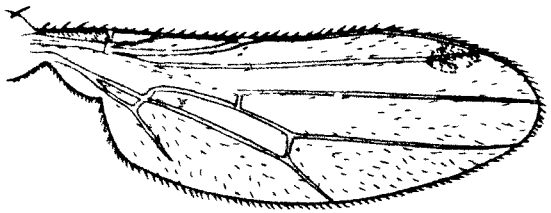
Figure, C - D; *Sepsis albopunctata*,

(A) Forewing; (B) Antenna

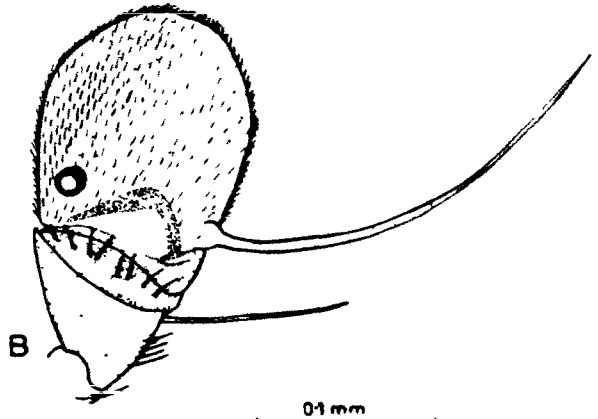


A

0·7 mm

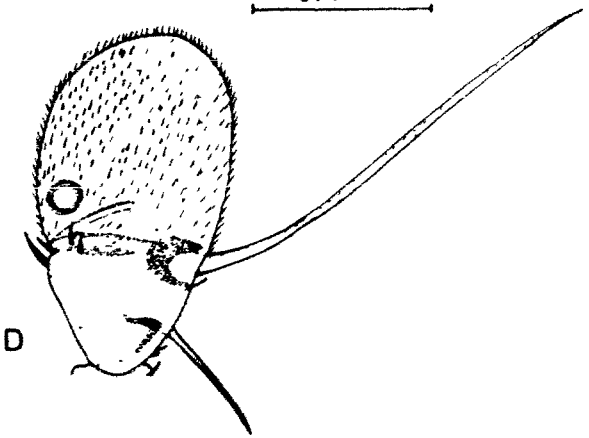


C



B

0·1 mm



D

PLATE-2

centimetersin surface area. Of these 70 to 75 per cent flies were in the process of copulation. The pairs stood still save for the males swinging their wings periodically. A pair remained in copula for 1.0 to 5.0 minutes. However, when disturbed the females flew away carrying the male on her back but then in about 2.0 to 5.0 minutes they again came to rest on the same heap. Mating activity was found to be greatly dependent on weather conditions and was at its peak during the months of July and August. Most of the matings could be observed during the morning hours from 10.00 a.m. to 11.00 a.m. when the temperature varied between 22.0 degree centigrade and 36.0 degree centigrade. The ratio of mating individuals was found to be 14:6:3 at 27.0 degree centigrade, 36.0 degree centigrade and 28.0 degree centigrade.

It was found that temperatures above 45.0 degree centigrade and below 15.0 degree centigrade not only reduced the mating activity but also adversely affected the population of flies in the field. Temperatures ranging from 20.0 to 38.0 degree centigrade were favourable for the mating of S. nitens(Figure - 1) whereas S. albopunctata preferred temperatures ranging between 22.0 degree centigrade and 36.0 degree centigrade (Figure - 2). A. niveipennis showed a still narrower range of temperature preference - 22.0 to 32.0 degree centigrade (Figure - 3).

Figure - 1, Effect of temperature on the mating of *Sepsis nitens*.

f - Favourable zone

uf - Unfavourable zone

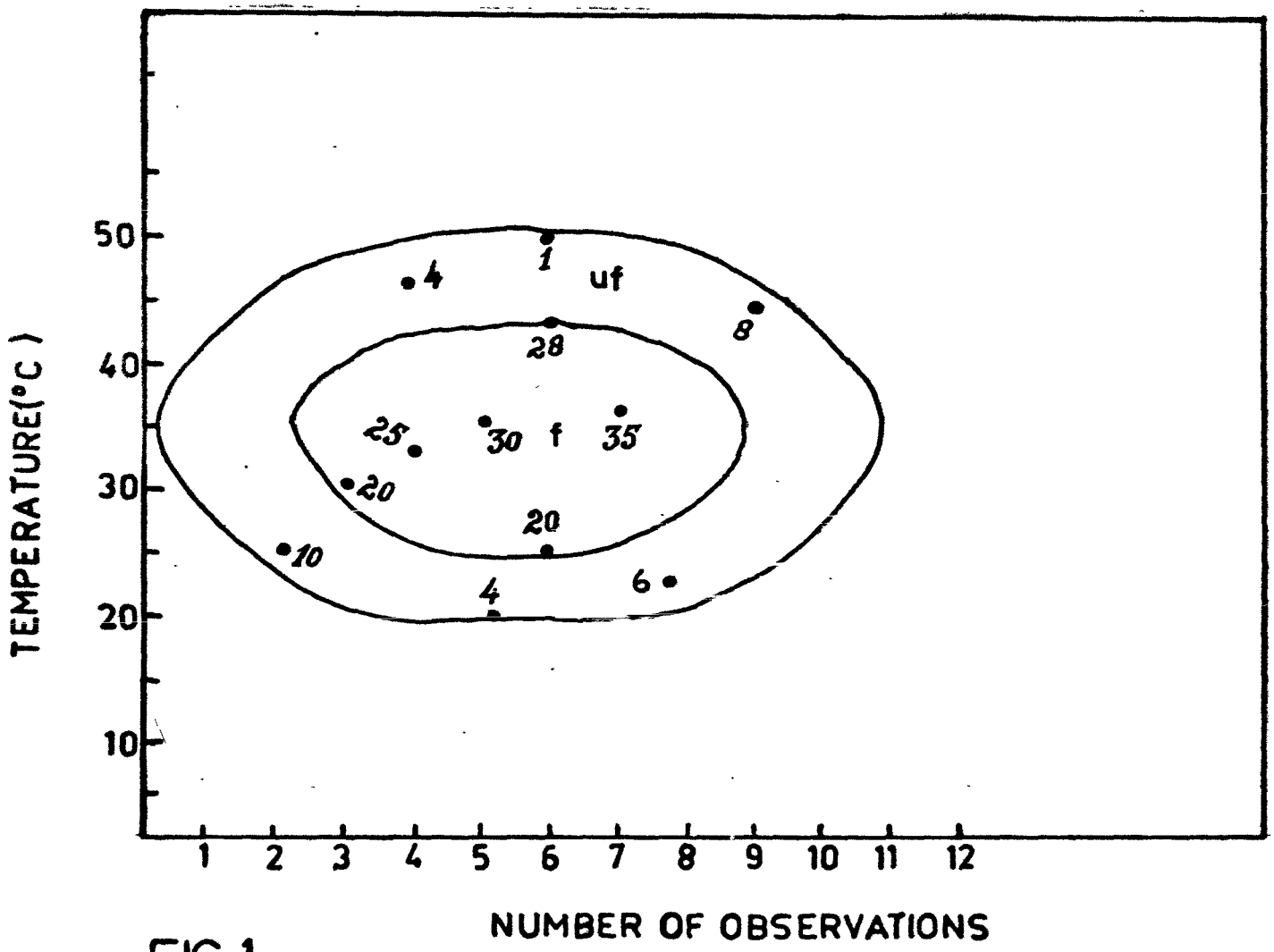

TEMPERATURE(°C)
50
40
30
20
10
1
2
3
4
5
6
7
8
9
10
11
12
NUMBER OF OBSERVATIONS
1
uf
4
8
28
25
30
f
35
20
20
10
4
6

FIG.1

Figure - 2, Effect of temperature on the mating of *Sepsis albopunctata*.

f - Favourable zone

uf - Unfavourable zone

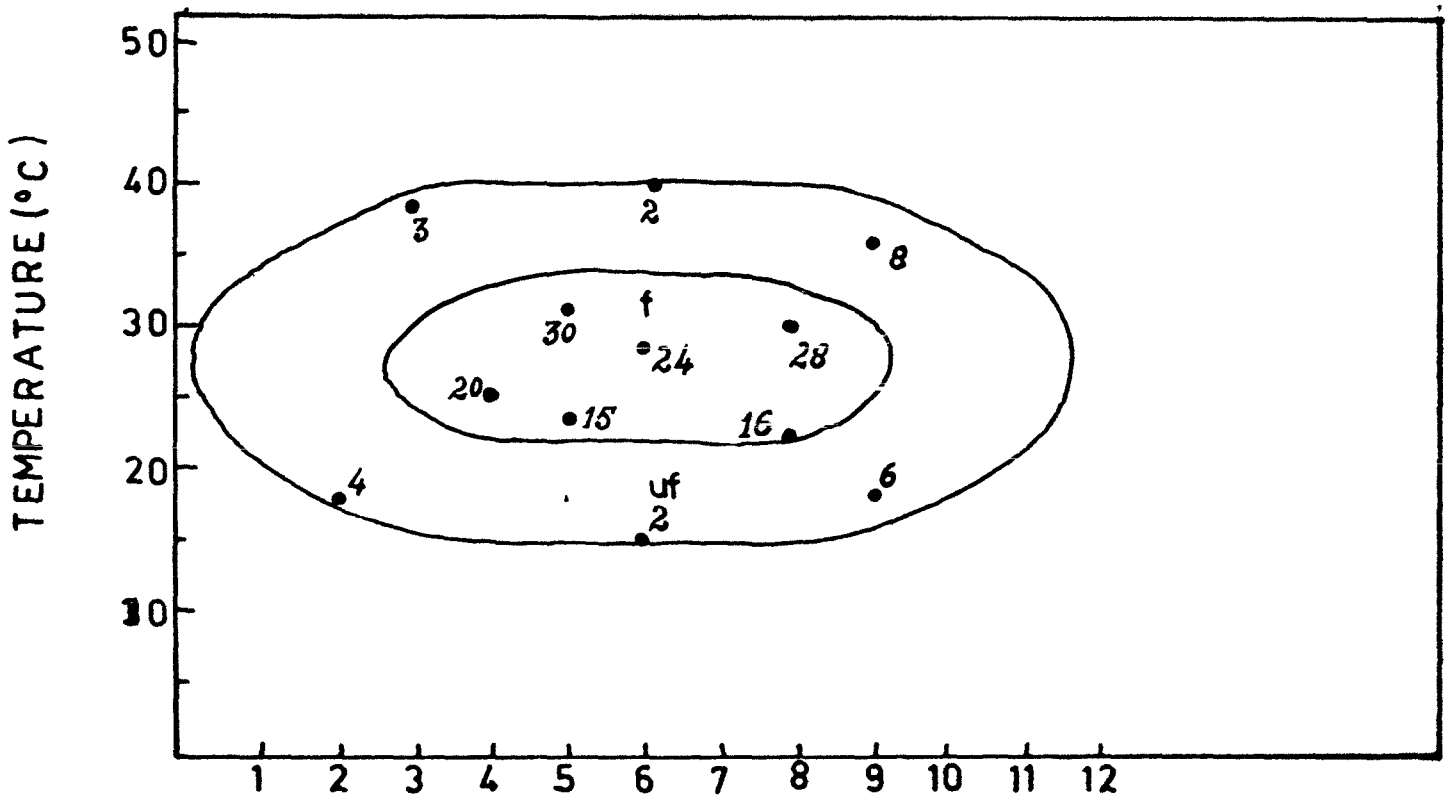

TEMPERATURE (°C)
50
40
30
20
10
1
2
3
4
5
6
7
8
9
10
11
12
NUMBER OF OBSERVATIONS
3
2
8
f
30
24
28
20
15
16
4
uf
2
6

FIG. 2

Figure - 3, Effect of temperature on the mating of *Australosepsis niveipennis*.

f - Favourable zone

uf - Unfavourable zone

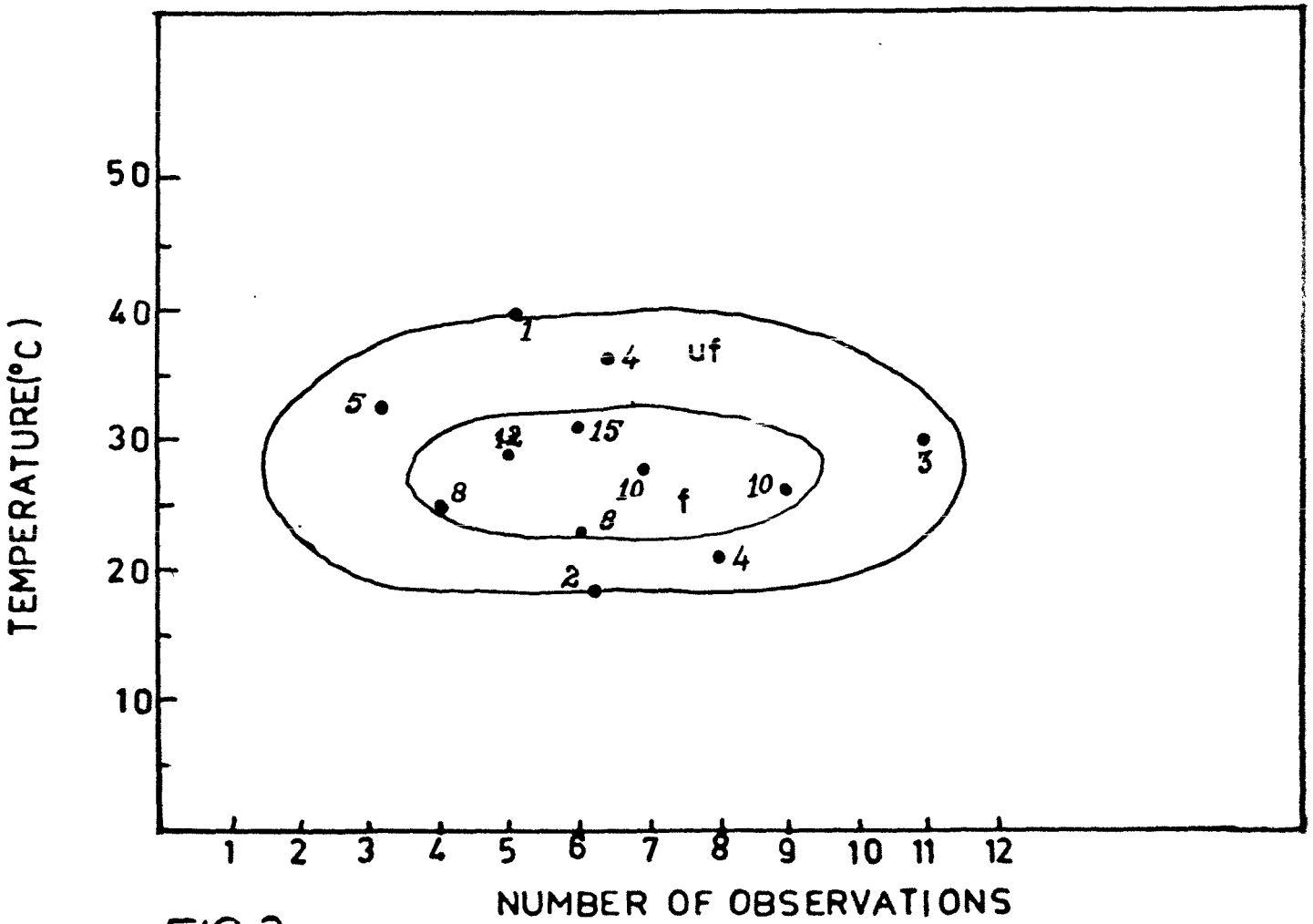

TEMPERATURE(°C)
50
40
30
20
10
1
2
3
4
5
6
7
8
9
10
11
12
NUMBER OF OBSERVATIONS
1
4
uf
5
12
15
3
8
10
f
10
8
4
2

FIG. 3

Oviposition and breeding media:

It was observed that for oviposition S. nitens, S. albopunctata and A. niveipennis prefer cow and buffalo dung than horse manure. These observations are in agreement with those of Hafez (1948) who found that Saltelliseps niveipennis, Sepsis lateralis and Sepsis thoracica persistantly avoided horse dung in favour of cow and buffalo dung for depositing their eggs. This may be due to the fact that temperature in horse dung is higher than in the buffalo dung and so it may be unsuitable for these flies to oviposit. Buffalo dung is rich in stercoraceous matter and temperature is never more than 32.0 degree centigrade at the surface.

Due to a high moisture content of freshly defecated calf dung, the flies found it rather difficult to walk on the surface of the dung and hence no eggs were laid in it.

Tests were also performed to find out the ovipositional preference of S. nitens, S. albopunctata and A. niveipennis. Masses of buffalo, cow and horse dung were collected within an hour after defecation and were exposed in the field from 9.00 a.m. to 4.00 p.m. for the females to oviposit. 500.00 grams of the dung was placed in a petri-dish. These masses were then brought to the laboratory and total number of flies emerged from each of

the dung mass was recorded by keeping them in rearing jars with an-inch-moist-sand-layer. The laboratory temperature during the course of these observations varied between 22.0 degree centigrade and 28.0 degree centigrade. 0.5 gram of yeast powder was added to each jar, for, as pointed out by Roeder (1953), the yeast fulfils the nutritional requirements provided by micro-organisms under field conditions. It was observed that longevity of S. nitens increased from 5.2 days to 6.5 days in males and from 6.0 days to 7.6 days in females. Similarly in the case of S. albopunctata the longevity increased from 5.4 days to 6.2 days in males and from 5.8 days to 6.8 days in females. In A. niveipennis a longevity of 5.6 days and 6.4 days in the case of males and females increased to 6.4 days and 7.1 days respectively. Number of flies emerged from buffalo dung was higher than the number emerged from cow dung. Oviposition was not observed in horse dung (Table - 1).

There is a gradual fall in moisture content of dung after it has been deposited in the field and this greatly effected the development of the larvae.

The moisture content of the horse dung was reduced from 70.0 per cent to 8.0 per cent in about five days and the dung almost dried up before the completion of larval period. It was probably due to this reason that only a small number of flies

Table 1. Number of flies emerging from equal masses of buffalo, cow and horse dung.

S.No.	Species	Number of flies emerged from dung			Longevity	
		Buffalo	Cow	Horse	Male	Female
1.	*Sepsis nitens*	55	50	0	6.5	7.6
2.	*Sepsis albopunctata*	24	20	0	6.2	6.8
3.	*Australosepsis niveipennis*	15	12	0	6.4	7.1

gathered around horse dung and the author failed to observe oviposition in it. As against this, cattle dung retains 25.0 per cent to 30.0 per cent of its moisture even after five days of defecation and can be said to provide a suitable medium for the development of larvae. Flies were attracted to such masses within two to three minutes of their deposition in the field.

SEASONAL ABUNDANCE OF SEPSID FLIES

During the present studies an attempt was made to study the seasonal abundance of three species - *Sepsis nitens*, *Sepsis albopunctata* and *Australosepsis niveipennis* over a period of one year. Weekly collections were made three times a day from 8.00 a.m. to 8.30 a.m. in the mornings, 12.00 noon to 12.30 p.m. and 6.00 p.m. to 6.30 p.m. in the evenings. Observations were recorded in an open field where cattle grazed. The number of flies, sitting on the heap of dung masses each with a surface area of 1000.00 square centimeters, was counted for 30.00 minutes during the course of an observation. The flies thus collected were brought to the laboratory and the relative abundance of each species was determined.

As pointed out by Thomsen (1956) and Andrewartha and Birch (1948), it was observed that ecological conditions greatly affected the population of these flies. Temperatures ranging from 26.0 degree centigrade to 32.0 degree centigrade were found to be highly favourable for all the three species. When the temperature varied between 15.0 degree centigrade and 26.0 degree centigrade the population of all the three species was greatly reduced and no flies could be seen in the field at a temperature

below 15.0 degree centigrade and above 45.0 degree centigrade irrespective of other ecological conditions. Two distinct peaks could be determined with respect to temperature conditions. One in March and April when the temperature ranged from 24.0 to 36.0 degree centigrade and the other was in August and September when temperature varied from 22.0 degree centigrade to 34.0 degree centigrade. A gradual fall in the population density of all the species was observed as the temperature fell below 26.0 degree centigrade during the colder months of the year. In December and January when the temperature varied between 20.0 degree centigrade and 15.0 degree centigrade the population became very scarce and no flies could be found when it was below 15.0 degree centigrade. It may, thus be concluded that lethal temperatures for S. nitens, S. albopunctata and A. niveipennis lie above 45.0 degree centigrade and below 15.0 degree centigrade (Figure, 4-6).

The flies could be seen throughout the day in the field though the highest number was collected during the noon hours from 12.00 a.m. to 12.30 p.m. However, under such conditions the flies preferred to sit in cool and shady places. It is quite possible that the flies avoid bright sun light. In the rainy season when the dung surface gets wet the flies are unable to walk on the surface of the dung mass, a large number of them

can be found sitting on grasses and other vegetation. A large number of S. nitens and S. albopunctata were found infected by a mite belonging to the family Parasittidae. The mites remain attached to the abdomen and probably survive on the body juices of the host (Edmond, 1950). When mites are transmitted to the grazing animals through the agency of flies, they may cause itching to them.

Figure - 4, Population of *Sepsis nitens*, *Sepsis albopunctata* and *Australosepsis niveipennis* during the morning hours from 8.00 a.m. to 8.30 a.m.

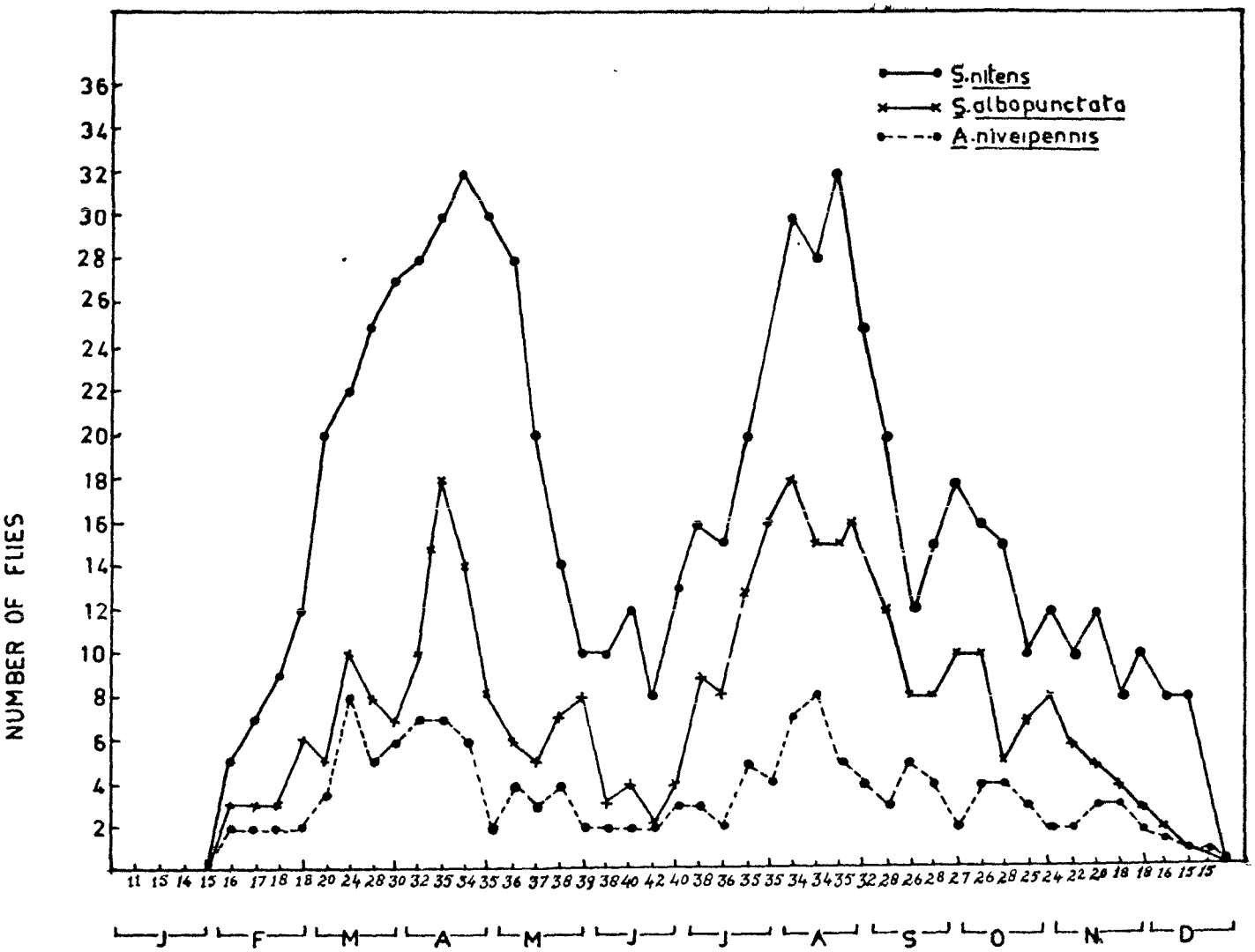

S.nitens
S.albopunctata
A.niveipennis
NUMBER OF FLIES
TEMPERATURE (°C)
J
F
M
A
M
J
J
A
S
O
N
D

FIG. 4

Figure - 5, Population of *Sepsis nitens*, *Sepsis albopunctata* and *Australosepsis niveipennis* during the noon hours from 12.00 a.m. to 12.30 p.m.

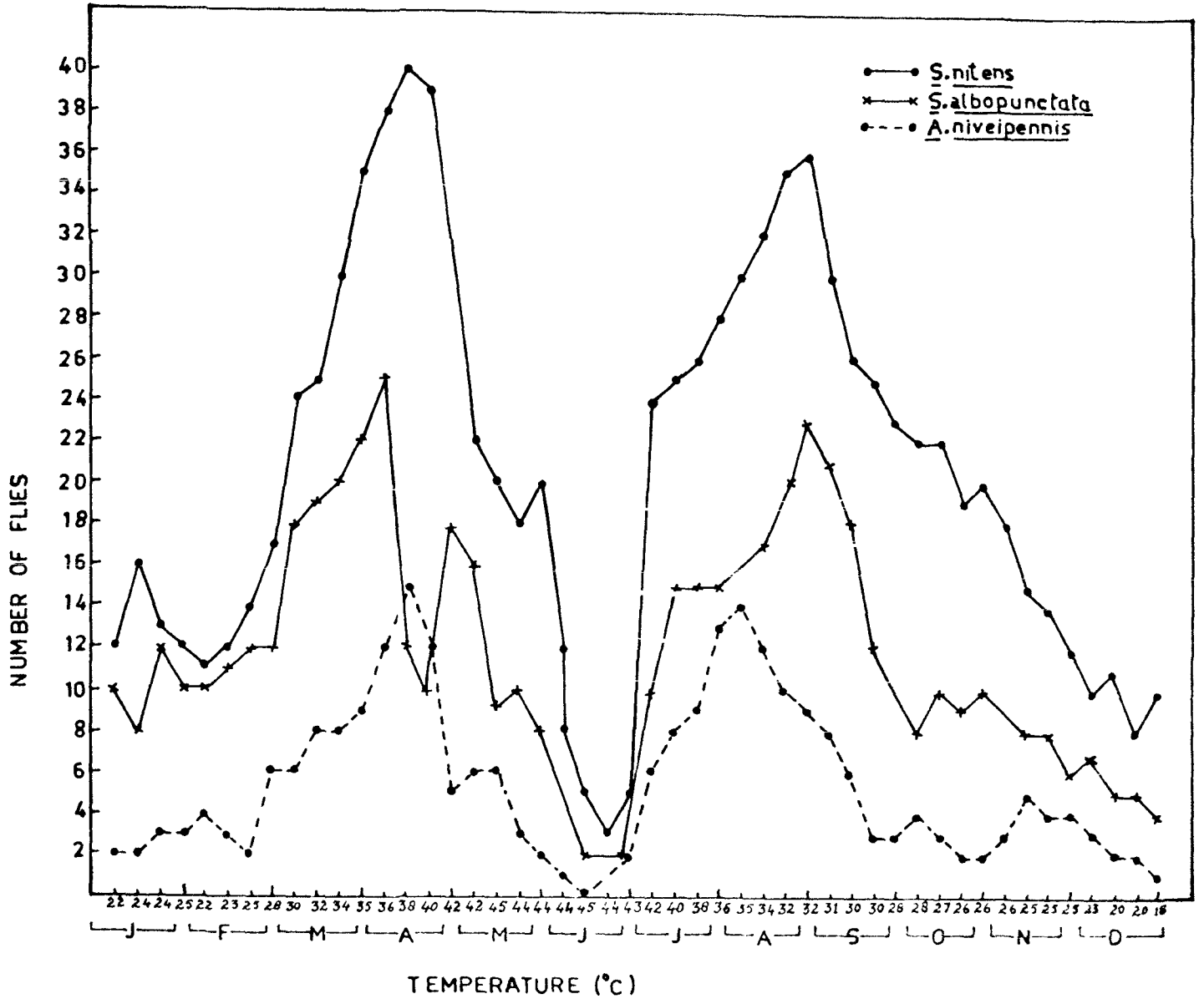

S.nitens
S.albopunctata
A.niveipennis
NUMBER OF FLIES
TEMPERATURE (°C)
J
F
M
A
M
J
J
A
S
O
N
D

FIG. 5

Figure - 6, Population of *Sepsis nitens*, *Sepsis albopunctata* and *Australosepsis niveipennis* during the evening hours from 6.00 p.m. to 6.30 p.m.

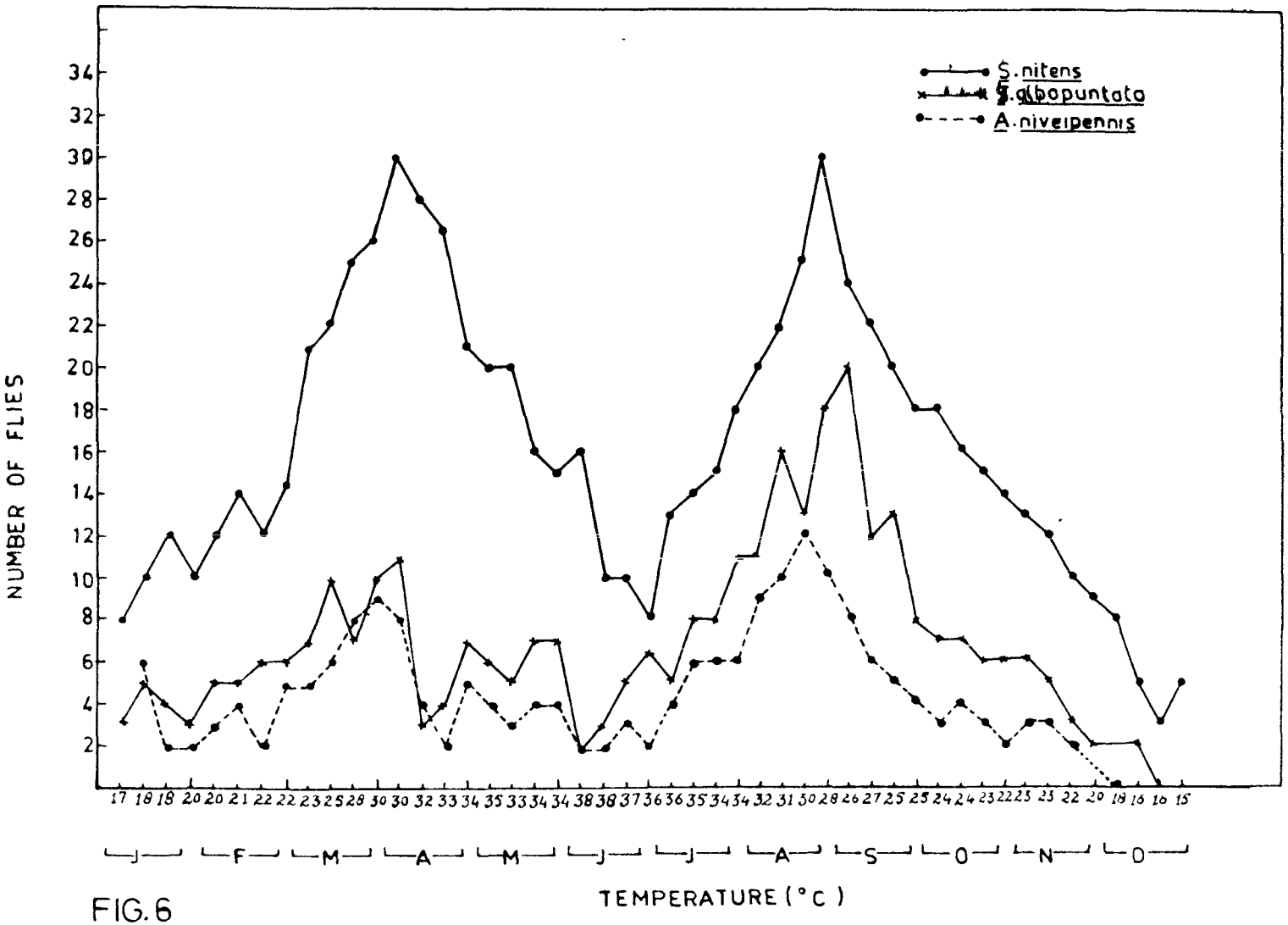

S. nitens
S. albopuntata
A. niveipennis
NUMBER OF FLIES
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
17 18 18 20 20 21 22 22 23 25 28 30 30 32 33 34 35 33 34 34 38 38 37 36 36 35 34 34 32 31 30 28 26 27 25 25 24 24 23 22 22 23 23 22 20 18 16 16 15
J F M A M J J A S O N D
TEMPERATURE (°C)

FIG. 6

CONCLUSIONS

1. Three species of Sepsis flies *S. nitens*, *S. albopunctata* and *A. niveipennis* are commonly found attacking dairy cattle in Aligarh. Of these, *S. nitens* is predominately abundant.

2. Mating occurs on the dung masses. A temperature ranging between 24.0 degree centigrade and 38.0 degree centigrade is most favourable for mating purposes.

3. It seems that Sepsid flies prefer buffalo dung for oviposition and no oviposition occurred on horse dung.

4. The flies did not deposit any eggs under laboratory conditions. However, under field conditions a favourable zone of temperature for oviposition was found to lie between 24.0 degree centigrade and 38.0 degree centigrade.

5. When yeast powder was added to the diet the longevity of *S. nitens*, *S. albopunctata* and *A. niveipennis* increased from 5.2, 5.4 and 5.6 days to 6.5, 6.2 and 6.4 days respectively in males and from 6.0, 5.8 and 6.4 days to 7.6, 6.8 and 7.1 days respectively in the case of females.

SUMMARY

Flies belonging to the family Sepsidae cause myiasis in man and livestock. They are cosmopolitan in distribution and three species - Sepsis nitens, Sepsis albopunctata and Australosepsis niveipennis are commonly found around cattle in Aligarh. The mating activity is at the highest when the temperature varies between 24.0 degree centigrade and 38.0 degree centigrade. However, irrespective of weather conditions, no flies were seen by the author at a temperature below 15.0 degree centigrade and above 45.0 degree centigrade.

The flies readily oviposited on freshly defecated dung in the field but no oviposition occurred when the dung was three-day-old.

Fresh buffalo, cow and horse dung were provided for oviposition but all the three species preferred buffalo dung for laying their eggs. Horse dung was least preferred.

The highest number of the flies in the field was seen when the temperature ranged between 22.0 degree centigrade and 36.0 degree centigrade. Two peaks were noticeable, one in March and April when the temperature varied from 24.0 to 36.0 degree centigrade and the other in August and September when

the temperature ranged between 22.0 degree centigrade and 34.0 degree centigrade.

In the month of March and April when the flies were abundant in the field, a mite belonging to the family Parasittidae was seen attached to the abdomen of S. nitens and S. albopunctata.

The longevity of the flies increased when yeast powder was added to their diet. In the case of males of S. nitens, S. albopunctata and A. niveipennis the longevity increased from 5.2, 5.4 and 5.6 days to 6.5, 6.2 and 6.4 days respectively while in females it increased from 6.0, 5.8 and 6.4 days to 7.6, 6.8 and 7.1 days respectively.

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